

6-1 Study Guide and Intervention *(continued)***Graphing Quadratic Functions**

Maximum and Minimum Values The y-coordinate of the vertex of a quadratic function is the maximum or minimum value of the function.

Maximum or Minimum Value of a Quadratic Function	The graph of $f(x) = ax^2 + bx + c$, where $a \neq 0$, opens up and has a minimum when $a > 0$. The graph opens down and has a maximum when $a < 0$.
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Example

Determine whether each function has a maximum or minimum value. Then find the maximum or minimum value of each function.

a. $f(x) = 3x^2 - 6x + 7$

For this function, $a = 3$ and $b = -6$.

Since $a > 0$, the graph opens up, and the function has a minimum value.

The minimum value is the y-coordinate of the vertex. The x-coordinate of the vertex is $\frac{-b}{2a} = \frac{-(-6)}{2(3)} = 1$.

Evaluate the function at $x = 1$ to find the minimum value.

$f(1) = 3(1)^2 - 6(1) + 7 = 4$, so the minimum value of the function is 4.

b. $f(x) = 100 - 2x - x^2$

For this function, $a = -1$ and $b = -2$.

Since $a < 0$, the graph opens down, and the function has a maximum value.

The maximum value is the y-coordinate of the vertex. The x-coordinate of the vertex is $\frac{-b}{2a} = -\frac{-2}{2(-1)} = -1$.

Evaluate the function at $x = -1$ to find the maximum value.

$f(-1) = 100 - 2(-1) - (-1)^2 = 101$, so the maximum value of the function is 101.

Exercises

Determine whether each function has a maximum or minimum value. Then find the maximum or minimum value of each function.

1. $f(x) = 2x^2 - x + 10$

2. $f(x) = x^2 + 4x - 7$

3. $f(x) = 3x^2 - 3x + 1$

4. $f(x) = 16 + 4x - x^2$

5. $f(x) = x^2 - 7x + 11$

6. $f(x) = -x^2 + 6x - 4$

7. $f(x) = x^2 + 5x + 2$

8. $f(x) = 20 + 6x - x^2$

9. $f(x) = 4x^2 + x + 3$

10. $f(x) = -x^2 - 4x + 10$

11. $f(x) = x^2 - 10x + 5$

12. $f(x) = -6x^2 + 12x + 21$

13. $f(x) = 25x^2 + 100x + 350$

14. $f(x) = 0.5x^2 + 0.3x - 1.4$

15. $f(x) = \frac{-x^2}{2} + \frac{x}{4} - 8$